Section II (Remarks)

No amendments to the claims are made herewith.

Claim Rejections

In the April 12, 2006 Office Action, claims 1-8 and 10-51 were rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. In particular, it was asserted that the claims contain subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention. April 12, 2006 Office Action, ¶ 4. Such rejection is traversed.

A. Law Regarding Written Description Requirement Under 35 U.S.C. 112

A description as filed is presumed to be adequate, unless or until sufficient evidence or reasoning to the contrary has been presented by the examiner to rebut the presumption. See, e.g., *In re Marzocchi*, 439 F.2d 220, 224, 169 USPQ 367, 370 (CCPA 1971); MPEP 2163.04 (emphasis added). The Federal Circuit has made clear that the examiner bears the burden of demonstrating a lack of written description, for example:

> The examiner ... "bears the initial burden . . . of presenting a *prima facie* case of unpatentability." *In re Oetiker*, 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992). Insofar as the written description requirement is concerned, that burden is discharged by "presenting evidence or reasons why persons skilled in the art would not recognize in the disclosure a description of the invention defined by the claims." *In re Wertheim*, 541 F.2d 257, 263, 191 USPQ 90, 97. Thus, **the burden placed on the examiner varies, depending upon what the applicant claims.** If the applicant claims embodiments of the invention that are completely outside the scope of the specification, then the examiner or Board need only establish this fact to make out a *prima facie* case. *Id.* at 263-64, 191 USPQ at 97. **If, on the other hand, the specification contains a description of the claimed invention, albeit not in *ipsis verbis* (in the identical words), then the examiner ..., in order to meet the burden of proof, must provide reasons why one of ordinary skill in the art would not consider the description**

sufficient. *Id.* at 264, 191 USPQ at 98.

In re Alton, 76 F.3d 1168, 37 USPQ2d 1578, 1583 (Fed. Cir. 1996) (emphasis added).

B. Disclosure of the "Uncut" Limitation

With respect to claims 1-8 and 10-25, the examiner was unable to find support for the "uncut" limitation as recited in the present claims. Office Action, ¶ 5. Discussion of such support is provided below.

As a matter of background, one well-recognized difficulty in the manufacture of microelectronic and optoelectronic devices has been providing large-area, low defect density GaN and other III-V nitride materials. Embodiments of the present invention overcome this difficulty. For example, one embodiment provides a vapor phase growth process for forming a large area, uniformly low dislocation density single crystal III-V nitride material on a substrate, such process including (i) a first phase including one or more steps of growing the III-V nitride material on the substrate by a vapor phase growth technique under pitted growth conditions, and (ii) a second phase including one or more steps of growing the III-V nitride material by the vapor phase growth technique under pit-filling conditions effecting closure of pits and annihilation of defects on a growth surface of the III-V nitride material. No cutting is required to yield large area, uniformly low dislocation density single crystal III-V nitride material.

Example 1 in the present disclosure (i.e., including **paragraphs [00106]-[00112]**) describe the growth of a gallium nitride wafer having a diameter of 2.3 inches produced by GaN HVPE growth on a sapphire substrate. No cutting or slicing was disclosed in connection with fabrication of this 2.3 inch diameter wafer (i.e., *in contrast* to the slicing and orthogonal growth

steps **required** to fabricate large area GaN according to methods disclosed by Motoki in U.S. Patent 6,468,882. Such disclosure alone is adequate support for the "uncut" limitation.

The disclosure in the present application of cutting ***following growth of large-area GaN*** as a possible finishing step does not preclude the claiming of the intermediate uncut product.[1] See, e.g., **paragraph [0096]**:

> The grown GaN **then** is sized appropriately, to a predetermined size, > 2 inches diameter, for example, by an appropriate technique, such as for example mechanical grinding, or sandblasting, or **laser cutting.**

From the foregoing passage, it is clear that the large area "> 2 inches diameter" GaN was grown first, before any cutting step. Clearly Applicants were aware at the time of filing of the desirability to re-size GaN ***following growth*** to a desirable end use application by applying well-known cutting techniques. Unlike Motoki, however, nothing in the present application in any states or otherwise suggests that a cutting step is required to yield large-area, low defect density GaN.

In view of the demonstrably adequate written description in the original disclosure, withdrawal of the rejection under 35 USC § 112 of claims 1-8 and 10-25 is respectfully requested.

[1] There exists no prohibition against claiming intermediate products. See, e.g., U.S. Patent 6,686,013 at claims 8-10 (each claiming "[a]n intermediate product..."); MPEP 806.04(b) ("Distinctness [for restriction purposes] is proven if the intermediate and final products do not overlap in scope and are not obvious variants and it can be shown that the intermediate product is useful other than to make the final product.").

C. Disclosure of the "Grown Exclusively In a Bulk Growth Direction Along the C-Axis" Limitation

With respect to claims 26-52, the examiner was unable to find support for the "uncut" limitation as recited in the present claims. Office Action, ¶ 6. Discussion of such support is provided below.

As indicated previously, certain embodiments of the present invention are directed to III-V single crystal growth with a vapor phase process including (i) a first phase including one or more steps of growing the III-V nitride material on the substrate by a vapor phase growth technique under pitted growth conditions, and (ii) a second phase including one or more steps of growing the III-V nitride material by the vapor phase growth technique under pit-filling conditions effecting closure of pits and annihilation of defects on a growth surface of the III-V nitride material.

Microscopic recessed pits are formed on the surface during the pitted growth conditions, and such pits are subsequently filled during the pit-filling conditions and further material grown thereon to yield low-defect density crystalline material. The term "pit" as used in the present application "refers to cavities, depressions, localized indentations, and similar surface artifacts on the growth surface." Application, ¶ [0038]. **Formation and filling of the microscopic pits, however, provides no contribution to bulk growth.**

During pitted growth conditions, the flat substrate between pits is grown in the c-direction while the pit facets are formed. . Such point is made in paragraphs [0056], as follows:

> [0056] During the growth on the pitted surface of the GaN under pitted growth conditions, there are at least two **microscopic** growth directions: (1) the

> aforementioned **growth direction along the growth direction)**, and (2) along the facets of th

A similar result occurs during pit-filling, as explained at

> [0083] Prior to the completion of pit-filling, tw exist, namely, the growth on the c-plane, and the **After the pits are completely filled, only the** Considering the steps required to form a GaN polishing and chemical-mechanical polishing well as mechanical grinding or lapping of the **thickness of the final c-plane growth should b at the front surface after the GaN wafer uniformly c-plane growth material.**

Finally, paragraph [0085] clarifies the pit-filling growth

> [0085] ... Alternately, multiple cycles of pit- be employed to further reduce dislocation den **growth of the III-V nitride material in the pit in the pits should be roughly c-axis growth bu**

To re-emphasize the previous points, microscopic grow **"bulk"** direction as provided in claims 26-52. Durin microscopic pits are formed, the surface growth directio ¶ [0056]. During pit-filing growth conditions, microsco growth direction that is roughly c-axis (but tilted) [Appli pits are filled, only **the c-plane growth direction exists.**

Thus, the limitation that the "single crystal III-V nitride growth direction along the c-axis" is supported by the p [0056], [0083], and [0086], and withdrawal of the reject is respectfully requested

C. Disclosure of the "Grown Exclusively In a Bulk Growth Direction Along the C-Axis" Limitation

With respect to claims 26-52, the examiner was unable to find support for the "uncut" limitation as recited in the present claims. Office Action, ¶ 6. Discussion of such support is provided below.

As indicated previously, certain embodiments of the present invention are directed to III-V single crystal growth with a vapor phase process including (i) a first phase including one or more steps of growing the III-V nitride material on the substrate by a vapor phase growth technique under pitted growth conditions, and (ii) a second phase including one or more steps of growing the III-V nitride material by the vapor phase growth technique under pit-filling conditions effecting closure of pits and annihilation of defects on a growth surface of the III-V nitride material.

Microscopic recessed pits are formed on the surface during the pitted growth conditions, and such pits are subsequently filled during the pit-filling conditions and further material grown thereon to yield low-defect density crystalline material. The term "pit" as used in the present application "refers to cavities, depressions, localized indentations, and similar surface artifacts on the growth surface." Application, ¶ [0038]. **Formation and filling of the microscopic pits, however, provides no contribution to bulk growth.**

During pitted growth conditions, the flat substrate between pits is grown in the c-direction while the pit facets are formed. . Such point is made in paragraphs [0056], as follows:

> [0056] During the growth on the pitted surface of the GaN under pitted growth conditions, there are at least two **microscopic** growth directions: (1) the

> aforementioned **growth direction along the c-axis (which is an average growth direction)**, and (2) along the facets of the pits. ... .

A similar result occurs during pit-filling, as explained at paragraph [0083]:

> [0083] Prior to the completion of pit-filling, two microscopic growth directions exist, namely, the growth on the c-plane, and the growth on the facets of the pits. **After the pits are completely filled, only the c-plane growth direction exists.** Considering the steps required to form a GaN wafer, which include lapping, polishing and chemical-mechanical polishing of the front (growth surface) as well as mechanical grinding or lapping of the back side (substrate side), the **thickness of the final c-plane growth should be such as to allow the material at the front surface after the GaN wafer forming steps to remain a uniformly c-plane growth material.**

Finally, paragraph [0085] clarifies the pit-filling growth angle, as follows:

> [0085] ... Alternately, multiple cycles of pit-forming and pit-filling steps can be employed to further reduce dislocation density. **Concerning the angle of growth of the III-V nitride material in the pits, the general growth direction in the pits should be roughly c-axis growth but tilted.**

To re-emphasize the previous points, microscopic growth direction should not be confused with **"bulk"** direction as provided in claims 26-52. During the pitted growth condition in which microscopic pits are formed, the surface growth direction remains along the c-axis. Application, ¶ [0056]. During pit-filing growth conditions, microscopic pits are filled by growth at a general growth direction that is roughly c-axis (but tilted) [Application, ¶ [0056]). After the microscopic pits are filled, **only the c-plane growth direction exists.** Application, ¶ [0083]

Thus, the limitation that the "single crystal III-V nitride material [is] grown exclusively in a bulk growth direction along the c-axis" is supported by the present application in at least paragraphs [0056], [0083], and [0086], and withdrawal of the rejection under 35 USC § 112 of claims 26-52 is respectfully requested

CONCLUSION

Claims 1-8 and 10-51 as provided herein are fully patentably distinguished over the art and in allowable condition. Allowance of the claims therefore is requested and merited.

If any issues remain outstanding, incident to the formal allowance of the application, the examiner is requested to contact the undersigned attorney at (919) 419-9350 to discuss their resolution, in order that this application may be passed to issue at an early date.

Respectfully submitted,

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